

calories. Also, because it is in the same functional form as shortening it does not have to be rehydrated. The present invention is very bland so it does not change the flavor of the finished product. Fat-replacement products of the present invention can be made in both solid and liquid form, depending on the functional requirements of the user.

In United States Patent 5,492,715, hydrolysis or polymerization is not used. It is just a mix and blend procedure. But in embodiments of the present invention the properties of the rice flour are being changed. The rice syrup enhances the handling characteristics of the product and also increases the heat transfer during extrusion.

Another unique feature is the enzyme hydrolysis with a very low moisture content. The standard in the corn and rice industries is to do dry substance phases (DSP) of 30%-45% moisture. Usually you need high water activity levels 55%-70% is usually needed to get good enzyme activity. But with embodiments of the present invention the water content is 10%-20%.

In working with food systems you want to develop foods that will contain fat, and embodiments of the present invention can mimic that fat. One example is sausage, where fat is added to enhance the flavor and texture.

In tests, medium grain rice flour was passed through a Wenger TX-57 extruder with some added water but no added enzymes. These were control runs. The flour and water were continually mixed together as they passed through the extruder. There were different temperatures in each zone of the extruder. There was no significant hydrolysis. In other tests, enzymes were added and the amount of water was varied. Such tests were run at 100-2000 psi, and nominally about 500 psi.

There is a relationship between pressure and temperature, so a moderate pressure of 500 psi can be

expected to generate the desired temperatures. In one test, the temperature increased as the water content was decreased. The product discharge temperature of 100° C or 94° C is higher than the temperature within the last zone of the extruder because a steam jacket was placed near the end of the last zone that raises the temperature and thus inactivates the enzyme. The enzyme becomes inactive around 90°C, and, of course, water boils at 100°C.

In some tests, monoglyceride and lecithin emulsifiers were added. The monoglyceride reacts with the starches. The desired range of DP<8 to DP>7 runs of 33.5-66.5 in the low range, to 66-34 in the high range. In this range from DP>7 of 33 to 66%, achieved through extrusion, the product is much more functional than just rice flour, and also more flexible. And the glucose, maltose, multotriose, maltotetrose, multopentose, multohexose, and multoheptose molecules all act as fat replacers.

The present invention is a combination of hydrolyzed rice flour and rice syrup that mimics fat in texture and flavor. This combination functions very similar to and sometimes better than fat in certain applications. The prior art has not been using extrusion for the hydrolysis of rice flour. Such extrusion promotes a short time conversion of the flour in the presence of an enzyme.

One extrusion machine used in tests was a Bonnet 2-1/8" single screw extruder. Such machine was reconfigured to include a steam jacket around the barrel. The Bonnet 2-1/8" single screw extruder is ordinarily used for polyethylene, e.g., melting resin and then extruding it. Stainless steel was used throughout the machine, as is good manufacturing practice in the food industry. In use, the rice flour, rice syrup and water are fed into the extruder, and the screw compresses the material under high temperature and sheer, and exits the material as a syrup at 220-230°F. A cooler can also

be added after the extruder to avoid product browning and  
carmelization. The sugars convert until cooled down, which  
changes the color but not the functionality. Another  
extruder as the cooler itself could be used. This product  
5 would exit at 90-100°F as a creamy-white semi-solid that could  
be cut or scooped out, like shortening.

An important point is that just about any type of  
extrusion device can be used. The Wenger extruder has twin  
screws. Another type tested had only one screw. Both types  
10 had to be adjusted for the proper temperature and pressure.

Although particular embodiments of the present invention  
have been described and illustrated, such is not intended to  
limit the present invention. Modifications and changes will  
no doubt become apparent to those skilled in the art, and it  
15 is intended that the present invention only be limited by the  
scope of the appended claims.